REMARKS

Prior to the present amendment, claims 1, 3-16 and 18-20 were pending in the present application. By the present amendment, claim 8 has been canceled and claims 1, 9, and 16 have been amended. Thus, claims 1, 3-7, 9-16 and 18-20 remain in the present application. Reconsideration and allowance of pending claims 1, 3-7, 9-16 and 18-20 in view of the above amendments and the following remarks are respectfully requested.

A. Rejections of Claims 1, 3-16 and 18-20 under 35 USC §103(a)

The Examiner has rejected claims 1, 3-16 and 18-20 under 35 USC §103(a) as being unpatentable over U.S. Patent Number 6,338,985 to Greenwood (hereinafter, "Greenwood") in view of U.S. Patent Application Publication Number 2003/0104657 to Kinsman et al. ("Kinsman"). For the reasons discussed below, Applicants respectfully submit that the present invention, as defined by amended independent claims 1, 9, and 16, is patentably distinguishable over Greenwood and Kinsman, either singly or in combination.

As disclosed in the present application, conventional multi-chip module or multi-component module (MCM) fabrication processes may reduce the reliability of particular surface mount components included in an MCM and thus reduce the reliability of the overmolded MCM itself. The present invention as defined by independent claims 1, 9 and 16 overcomes this reduction in reliability in overmolded MCMs brought forth by conventional MCM fabrication processes.

The present invention, as defined by amended independent claims 1, 9 and 16, includes a *surface mount component* (also referred to as "SMC"), having first and second terminals, where the SMC and its terminals are situated over a *laminate circuit board* (e.g., laminate circuit board 104 in Figure 1 or laminate circuit board 304 in Figure 3). First and second pads are also situated on the laminate circuit board and are coupled to the first and second terminals, respectively. As part of the solution to the shortcomings of the conventional technology, solder mask trench 124 (seen in Figure 1) is formed under a SMC, such as SMC 102 or SMC 302. More importantly, solder mask trench 124 is formed where, in the absence of the present invention, no solder mask opening would be formed.

Referring to Figure 1, by forming solder mask trench 124 underneath the SMC and within solder mask 112, moldable gap 125, with an increased height 128, is advantageously formed and is substantially larger than a conventional moldable gap. By contrast, in a conventional structure, solder mask 112 would fill the region between pads 106 and 108 underneath the SMC. As a result, a conventional moldable gap that would be formed between solder mask 112 and the bottom surface of the SMC would have a reduced height 130, as shown in Figure 1 of the present application.

Thus, by forming solder mask 124 within, i.e. between portions of, solder mask 112, embodiments according to the present invention advantageously achieve a significantly larger moldable gap, having height 128, that improves molding compound flow underneath the SMC and, consequently, minimizes void formation underneath the

SMC. As a result, embodiments according to the present invention advantageously minimize the risk of shorting between the terminals of the SMC during, for example, reflow assembly. See, e.g., the present application page 9, lines 19-21. Indeed, since the invention does not require complex changes to the existing technology, the disadvantages of the existing technology in having voids in molding compounds under an SMC are overcome without significantly increasing manufacturing costs. Thus, among other advantages, the reliability of the SMC and the overmolded MCM itself can be significantly increased in an economic manner.

In contrast, Greenwood provides a method for making chip size semiconductor packages wherein one or more vent openings through the substrate and solder mask can be used to displace the air in the gaps trapped between the die and the substrate and solder mask as underfill material is injected into the package assemblies. As acknowledged by the Examiner, however, Greenwood does not disclose that the solder mask trench is situated over a top surface of the substrate as defined by independent claims 1, 9 and 16.

Applicants submit that Kinsman does not teach or suggest use of a solder mask for accommodating or creating a trench in the solder mask and over a top surface of a *laminate circuit board underneath an SMC*, as disclosed and claimed by the present invention. As such, Kinsman cannot be combined with Greenwood to achieve the present invention. More particularly, Kinsman involves a transfer mold semiconductor packaging process which provides a substrate having a solder mask and a semiconductor chip mounted to a side of the substrate, such that the semiconductor chip can be received by a

void in a transfer mold. See, for example, Kinsman, paragraph 0008. Kinsman makes clear that semiconductor chip 40 is placed directly on substrate 12, with no gap whatsoever between chip 40 and substrate 12. For example, Kinsman states: "A semiconductor chip 40 is adhered (for example with a die attach adhesive 17) to substrate side 16, with solder mask 25 in the preferred embodiment being received between chip 40 and substrate 12." See paragraph 0025 of Kinsman and, for example, Figure 4 of Kinsman.

One reason for Kinsman's direct attachment of the die to the substrate is that Kinsman is directed to a different technology than the present invention. More particularly, the present invention addresses assembly of SMCs and other pre-packaged devices, for example semiconductor package 65 of Kinsman, on a printed circuit board, for example laminate circuit board 104 in Figure 1 of the present application. Thus, the present invention addresses a different level of integration than that addressed by Kinsman. While Kinsman is directed to packaging a die, the invention is directed to assembly of a number of pre-packaged dies as well as SMCs on a printed circuit board. Notwithstanding that Kinsman is not directed to any part of this universe, i.e. pre-packaged dies and SMCs to be assembled on a laminate circuit board, the invention is nonetheless directed to a narrower packaging universe, i.e. packaging SMCs on printed circuit boards.

Thus, Kinsman does not disclose or provide a motivation for creating a moldable gap under an SMC in a laminate circuit board as disclosed and claimed by the present

invention. Further, Kinsman does not even disclose or provide a motivation for creating a moldable gap under chip 40 of Kinsman. One reason is that die attach 17 is used to directly attach chip 40 to substrate 12, and there is no reason whatsoever for a moldable gap to be placed under chip 40. Indeed, Kinsman discloses the use of an elongated trench 35 in solder mask 25 merely to reduce shear stress and to prevent cracking of the solder mask. For example, as stated in Kinsman: "[T]he elongated trench provides stress relief at the mold void perimeter such that cracking of present solder mask materials at this location can be advantageously avoided." Paragraph 0029 of Kinsman.

However, Kinsman does not teach, suggest, or provide a motivation for a moldable gap underneath chip 40, nor does Kinsman teach that a reason to form such moldable gap is to improve molding compound integrity and to prevent formation of voids in the molding compound. Further, Kinsman is not directed to preventing the potential shorting between the two terminals of an SMC by preventing voids in the molding compound. Again, one reason for Kinsman's failure to teach or even suggest the claimed invention is that Kinsman addresses integration of a chip on a semiconductor package, while the invention is one level removed from that level of integration and the invention addresses integration of a number of pre-packaged devices, such as package 65 of Kinsman, as well as SMCs on a laminate circuit board.

As such, the problem addressed by the disclosure in Kinsman is separate and distinct from the problem addressed by the present invention as defined by independent claims 1, 9 and 16. For example, Kinsman explains that, during transfer molding, the

clamping forces applied by the mold body to a substrate can be quite high and that these high clamping forces introduce high shear forces in the solder mask, which can cause severe cracking of the solder mask. See, for example, Kinsman, paragraph 0006. Thus, the disclosure in Kinsman is directed to avoiding the cracking of the solder mask at the mold void perimeter by providing stress relief to the solder mask at the mold void perimeter, whereas the present invention is directed to improving molding compound flow underneath a SMC situated on a laminate circuit board.

Moreover, referring to Figure 3, and as briefly discussed above, Kinsman discloses the use of an elongated trench 35 in solder mask 25 that "is continuous about a periphery defined by the radial outermost portions of elongated trench 35." See Kinsman, paragraph 0024. Furthermore, as seen in Figure 4 of Kinsman and as stated in paragraph 0026, "transfer mold 50 is positioned to align at least a portion of void perimeter 56 over at least a portion of solder mask peripheral trench 35" so as to relieve stress on the solder mask at the mold void perimeter. See also paragraph 0029 of Kinsman.

Consequently, the disclosure in Kinsman does not suggest a combination with Greenwood for any purpose, and in fact Kinsman teaches away from using a solder mask trench *underneath a SMC* situated on a *laminate circuit board* to improve molding compound flow underneath an SMC and on a *laminate circuit board* as defined by amended independent claims 1, 9 and 16. Therefore, there is no suggestion to combine Greenwood and Kinsman and, even if combined, such purported combination would not achieve the present invention.

For the foregoing reasons, Applicants respectfully submit that the present invention as defined by amended independent claims 1, 9, and 16, is not taught, disclosed, or suggested by the art of record. As such, the claims depending from amended independent claims 1, 9, and 16 are, *a fortiori*, also patentable for at least the reasons presented above and also for additional limitations contained in each dependent claim.

B. Conclusion

Based on the foregoing reasons, the present invention, as defined by amended independent claims 1, 9, and 16, and the claims depending therefrom, is patentably distinguishable over the cited art. Thus, outstanding claims 1, 3-7, 9-16 and 18-20 are patentably distinguishable over the cited art. As such, and for all the foregoing reasons, an early allowance of all claims 1, 3-7, 9-16 and 18-20 remaining in the present application is respectfully requested.

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Respectfully Submitted,
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